

Am 6

United States
Environmental Protection
Agency

Environmental Sciences Research
Laboratory
Research Triangle Park, NC 27711

Research and Development

EPA-600/S7-80-179 Feb. 1981



Project Summary

Gaseous and Particulate Ammonia and Nitric Acid Concentrations: Columbus, Ohio Area—Summer 1980

R. S. Braman and T. J. Shelley

NEWARK PUBLIC LIBRARY

JUN 24 1981

U. S. GOVT. PUBS.
DEPOSITORY 376

Data are presented for gaseous ammonia and nitric acid and particulate ammonium ion and nitrate ion concentration in air samples collected in support of the PEPE-NEOS (Persistent Elevated Pollution Episodes—North East Regional Oxidant Study) during the summer of 1980. Ground-level samples were collected near Croton, Ohio; aerial samples were also taken from an aircraft during several flights. Sampling and analyses were accomplished using the hollow and packed tube tungstic acid method that permits short sampling times of 10-30 minutes. Feasibility of sampling from aircraft was established. Quality control was maintained by measuring the preconcentration tube efficiency before and during field analyses.

This Project Summary was developed by EPA's Environmental Sciences Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Recently, a new integrative sampling and analysis technique was developed for quantification of ambient concentrations of NH_3 and HNO_3 . Ambient air is sampled through a diffusion tube coated

on its inside surface with an amphoteric sorbent, tungsten VI oxide. Experimental conditions of such parameters as flow rate and residence time are set to ensure quantitative collection. After collection, the tube is heated to release the absorbed gases; NH_3 is released as NH_3 , and HNO_3 as NO_2 . The gases are desorbed into a carrier gas stream which is directed through a second identical diffusion tube. The second tube collects NH_3 and passes NO_2 ; NH_3 is released again by heating. Both NO_2 and NH_3 are converted to NO by passing the carrier gas through a heated bed of gold-coated quartz beads. Nitric oxide is then detected with a chemiluminescence NO_x analyzer.

Packed tubes containing tungsten oxide coated quartz beads held in place by quartz wool can be used to collect both gaseous and particulate forms of NH_3 and HNO_3 . In this case, thermal desorption results in two peaks, one corresponding to the sum of nitric acid and decomposed nitrates, the other to the sum of ammonia and decomposed, ammonium-containing particles.

The tungsten VI oxide technique was field tested in 1979-1980. The present documentation was performed during the last of the summer 1980 field tests and includes the first application using an airborne sampling platform. Short duration (1-20 minutes) sampling was taken from aircraft flying missions as

READEX
FICHE

EP 1.89/2:

Table 1. Concentrations of NH_3 , HNO_3 and Corresponding Particle Forms in Croton, Ohio

Day	Sample Time	$\text{HNO}_3(\text{g})$	$\text{HNO}_3(\text{p})$	$\text{HNO}_3(\text{s})$	$\text{NH}_3(\text{g})$	Concentrations (ng/h^*)	
						$\text{NH}_3(\text{p})$	$\text{NH}_3(\text{s})$
6 Aug	1212-1227	9.03			0.83		
	1330-1345						
6 Aug	1212-1227	9.03			0.83		
	1330-1345	8.60	7.60		0.99	3.99	
	1550-1515	10.47	6.32		0.76	6.10	
	1630-1645	11.30	6.30		1.18	4.05	
			6.26			3.30	
8 Aug.	1210-1225			12.46			5.62
	1252-1307			8.95			6.53
	1336-1353			8.20			4.89
	1412-1427			7.20			4.22
	1454-1509			5.47			4.03
	1533-1548			7.77			4.99
9 Aug.	1401-1416	1.51			1.49		
	1437-1453	5.16	4.37		1.58	1.79	
	1600-1615	1.51	6.33		1.49	3.32	
	1643-1658	8.59	2.94		0.78	2.31	
			5.08			3.60	

*Symbols (g), (p) and (s) denote concentrations for gases, particles and the sum.

part of the PEPE/NEROS* experiments; the sampling tubes were returned to a field laboratory for thermal desorption and analysis.

Results

Sampling occurred at two sites: Croton, Ohio and onboard the "Chem 1" aircraft flown by Environmental Measurements, Incorporated in PEPE/NEROS. Sampling at the rural site in Croton occurred approximately four feet above ground level near an isolated monitoring station maintained by the University of Minnesota. The position of "Chem 1" during sampling has not been documented for this report; a second research group is to match location with concentration to draw conclusions regarding atmospheric transformation and transport.

Results of the analyses of samples from Croton are given in Table 1. Both

packed tubes and diffusion tubes were used. The average nitrate in gaseous phase is almost twice (1.83) that in particles, i.e., 7.1 ng/l (2.5 ppbv, STP) as compared to 3.8 ng/l (1.4 ppbv). The average total nitrate as HNO_3 is 10.9 ng/l (3.9 ppbv). Ammonia in the gaseous phase averaged only about one fourth (0.26) of particle ammonia, i.e., 0.8 ng/l (1.0 ppbv) and 2.92 ng/l (3.8 ppbv). The average total ammonia as NH_3 averaged 3.71 ng/l (4.82 ppbv). All samples at Croton were taken in the afternoon from 1200-1700 hrs.

Aircraft samples were taken under a variety of conditions with flight path traversals through dispersed power plant plumes. Evidence of the variability in concentration values is given in Table 2 which shows one of six days (August 11, 1980) during which aircraft samples were taken. A total of 50 sampling periods were logged. Average total values for nitrate as HNO_3 and ammonia for all these samples were 14.9 ng/l (5.3 ppbv) and 5.3 ng/l (6.9 ppbv), respectively. The average gaseous and

Table 2. Aircraft Samples Taken During August 11, 1980 Flight of "Chem 1" in PEPE/NEROS.

Time	Concentrations (ng/h^*)	
	$\text{HNO}_3(\text{s})$	$\text{NH}_3(\text{s})$
1310-1321	30.7	10.5
1434	15.0	6.3
1939-1943	16.0	9.8
1945-1957	14.5	4.5
2003-2013	1.3	4.6
2040-2041	25.6	10.6
2317-2327	5.0	1.9

*Symbol (s) denotes sum of gas and particle

*Persistent Elevated Pollution Episodes—North East Regional Oxidant Studies.

particulate concentrations for nitrate as HNO_3 were 5.29 ng/l (1.9 ppbv) and 4.9 ng/l (1.7 ppbv), respectively; for ammonia these values are 2.8 ng/l (3.7 ppbv) and 3.0 ng/l (3.9 ppbv).

Quality assurance was maintained during the tests by checking collection tubes for leakage and by comparing the responses obtained after collection of known amounts of NH_3 to complete calibration curves generated prior to and following the field tests.

Conclusions

The summer 1980 field study in the Columbus, Ohio area demonstrated the practical use of a new integrative sampling and analysis technique based on the sorptive properties of tungsten VI oxide. Ambient concentrations of NH_3 and HNO_3 were documented for later use in studies of atmospheric transport and transformation. The small quantity of NH_3 and HNO_3 required for analysis makes possible short duration sampling (1-20 minutes) which can give valuable spatial resolution when sampling from an aircraft.

R. S. Braman and T. J. Shelley are with the University of South Florida, Department of Chemistry, Tampa, FL 33620.

W. A. McClenny is the EPA Project Officer (see below).

The complete report, entitled "Gaseous and Particulate Ammonia and Nitric Acid Concentrations: Columbus, Ohio Area—Summer 1980," (Order No. PB 81-125 007; Cost: \$6.50, subject to change) will be available only from:

National Technical Information Service

5285 Port Royal Road

Springfield, VA 22161

Telephone: 703-487-4650

The EPA Project Officer can be contacted at:

Environmental Sciences Research Laboratory

U.S. Environmental Protection Agency

Research Triangle Park, NC 27711

Table 3

Concentrations of 2014, 2015, and 2016, Concentration of 2014, 2015, and 2016, Concentration of 2014, 2015, and 2016

Year	Concentration	Concentration	Concentration	Concentration	Concentration
2014	1272-1277	1272	1272	1272	1272
2015	1272-1277	1272	1272	1272	1272
2016	1272-1277	1272	1272	1272	1272
2017	1272-1277	1272	1272	1272	1272
2018	1272-1277	1272	1272	1272	1272
2019	1272-1277	1272	1272	1272	1272
2020	1272-1277	1272	1272	1272	1272
2021	1272-1277	1272	1272	1272	1272
2022	1272-1277	1272	1272	1272	1272
2023	1272-1277	1272	1272	1272	1272
2024	1272-1277	1272	1272	1272	1272
2025	1272-1277	1272	1272	1272	1272
2026	1272-1277	1272	1272	1272	1272
2027	1272-1277	1272	1272	1272	1272
2028	1272-1277	1272	1272	1272	1272
2029	1272-1277	1272	1272	1272	1272
2030	1272-1277	1272	1272	1272	1272

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati OH 45268

Postage and
Fees Paid
Environmental
Protection
Agency
EPA 335



Official Business
Penalty for Private Use \$300